

Supported γ -Fe₂O₃ nanoparticles in CTF-1: A novel hybrid adsorbent for heavy metal sequestration

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In this study, we present a novel hybrid material using the triazine-based Covalent Organic Framework, CTF-1, as a support for γ -Fe₂O₃ nanoparticles synthesized *in situ*. This novel hybrid material harnesses both the high reactivity and selectivity of nanoparticles and the versatile structural properties and high specific surface area of microporous materials. The resulting γ -Fe₂O₃/CTF-1 was investigated by N₂ sorption, XRPD, Mössbauer spectroscopy and various high-resolution TEM techniques such as HRTEM, HAADF-STEM, EDXS and STEM-EELS. It was examined in the recovery of critical and precious metals and in the removal of heavy metals. The performance of γ -Fe₂O₃/CTF-1 in the recovery of critical metals is significantly higher and unprecedented in comparison to other Fe-based sorbents and even their surface-functionalized analogues. γ -Fe₂O₃/CTF-1 also exhibited remarkable maximum Hg saturation uptake that is comparable to benchmark adsorbents. The γ -Fe₂O₃/CTF-1 material also demonstrated fast and efficient removal of Hg from water, selectivity for Hg species in the presence of competing species and remarkable stability and recyclability. These highlight the potential of γ -Fe₂O₃/CTF-1 as a promising hybrid nanomaterial for water treatment technologies.

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